STORY

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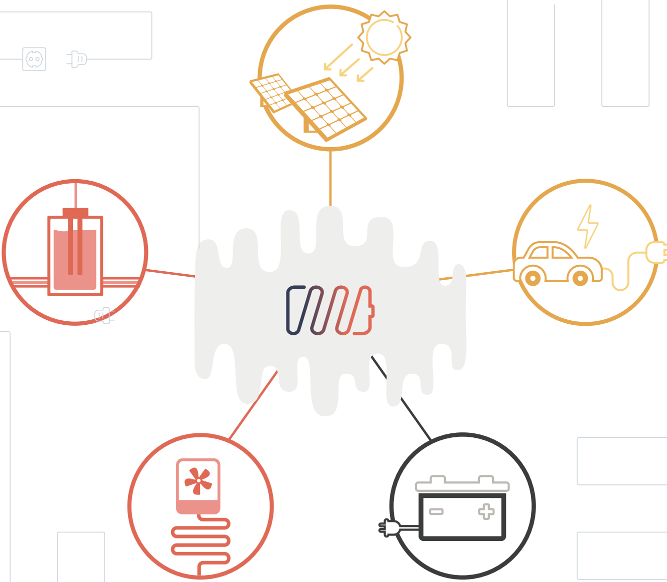
Project STORY – H2020-LCE-2014-3.

THE STORY PROJECT IS ALL ABOUT EXPLORING THE



ADDED VALUE OF STORAGE IN DISTRIBUTION SYSTEMS

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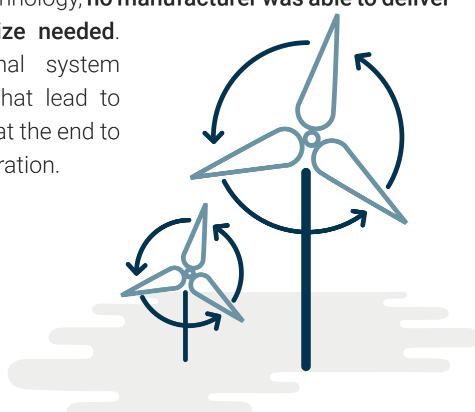
Project **STORY** was a challenging and successful project that presented opportunity for **18 partners** from **8 EU countries** to test and implement new technologies, develop new control algorithms, and learn, exchange and share knowledge with the world. The project was very demonstration oriented from its beginning, and in this brochure, we would like to share with you the **main outcomes and lessons** learnt from the demonstration pilots.

LECALE DISTRICT — N. IRELAND

Using the compressed air storage to store the excess energy from renewable energy sources

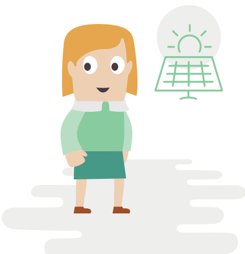
From the grid that is produced by **wind, PV and tidal generators** to **drive a compressor for storing compressed air in air storage cylinders (Compressed Air Energy Storage, CAES)**. The CAES plant can appear on the grid as either a **controllable load** or a **controllable generator.**

Although no company could provide technology at this scale, the low and medium pressure part was successfully designed and tested by STORY partners. The unit is operational, but due to being first of a kind at this scale, certification is still needed. In this demo the **main challenge** was, **adaptation of the technology to bigger scale** and although it is well known technology, **no manufacturer was able to deliver the unit at the system size needed**. This resulted in additional system development and design that lead to significant time delays and at the end to the termination of demonstration.



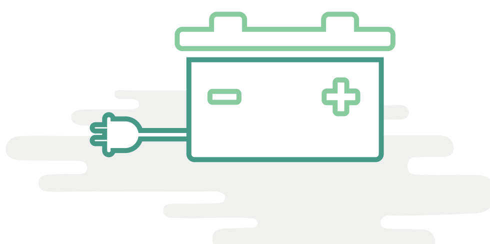
SUHA VILLAGE | SLOVENIA

Using community battery to solve the issues of high PV penetration in Suha village



In this demo, a **170 kW, 340 kWh storage unit was built and installed** in Suha village by the local DSO Elektro Gorenjska. The battery provided a flexible and robust energy supply for diverse applications and was used to stabilize the grid, improve power quality and efficiency, moderate peak demand of household, prevent reverse power flows and integrate renewable energy sources (RES).

Thanks to the **newly developed storage control**, the battery **increased self-sufficiency and self-consumption levels** of Suha village which leads to **decrease of transformer loading levels**, safer operation, and **transformer upgrade deferral**. Due to being custom made system and one of the first field battery implementation, some components of the battery resulted in high frequency noise production on a broad frequency spectrum. This disturbed communication of the neighbourhood smart meters with the network operator within the SCADA system.

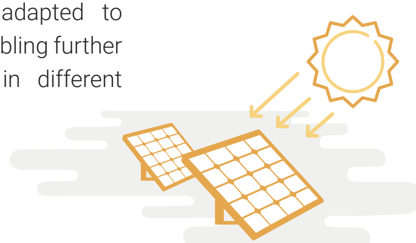


NAVARRA FACTORY — SPAIN

Using battery to increase the PV utilization and optimize factory's consumption profile

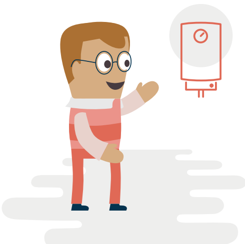
Navarra Factory production machines require a large amount of power (800 kW peak values) representing a considerable financial burden. In addition to the existing 113 kWp PV on the site **we added a 50 kW, 200 kWh battery energy storage system to improve the cost savings and create a business case for industrial self-consumption.**

The battery control management algorithms were constantly updated and adapted **from peak demand control to additional load shifting functionality** when factory production schedule changed. **Our effort resulted in decreased energy peak power levels and associated costs**, together with the overall energy consumption of the factory. In this demo we had to tackle not only technical challenges but also challenges related to legislation. **In the beginning, the Spanish legislation prevented storage interaction with the main grid,** which severely limited the operation of the storage. After the legislative changes were adopted, the storage control was updated and adapted to interact with the main grid enabling further enhancement of operation in different conditions.



BENEENS FACTORY / BELGIUM

Multi energy grid in an industrial area at the Beneens factory that manufactures wood-based products

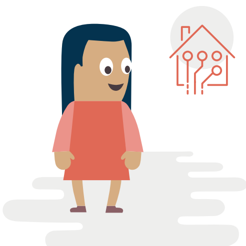


A new wood fired boiler (1.6 MW) with a heat delivery of 150 °C has been built, fueled by timber waste generated from the wood-based manufacturing process. The boiler is connected to an **Organic Rankine Cycle (ORC) that can provide up to 90 kW of electric power. To increase the flexibility of the system we have added thermal energy storage based on a hot water storage tanks.**

We have successfully made efficiency enhancements and active controls of ORC using thermal storage. **The unit provides both, heat for heating the office space and electricity, which is used by smart battery management to reduce the factory's peak demand.** The main challenge was integration of the boiler with ORC and ensuring system's high efficiency. The boiler is operational and stable, but the full thermal output was hard to achieve. **We identified a lack of technology integrator**, who would have the knowledge and experience of implementation and interoperability with other complementary technologies, i.e. ORC and hot water boiler combination and optimisation of their control.

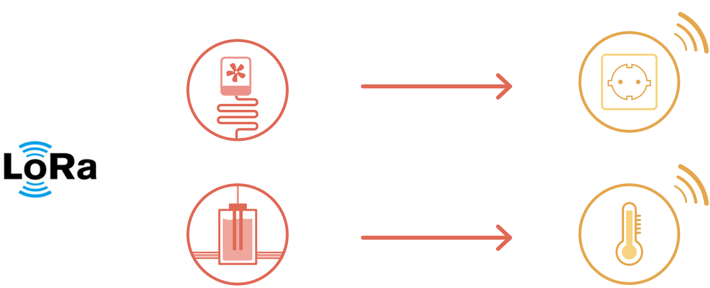
OUD-HEVERLEE | BELGIUM

Residential and neighbourhood storage implementation



This two-level demonstration showed the potential of storage for the end consumers, the distribution grid operator, which supervise the network, energy supplier of the households and an aggregator who utilizes flexibility of thermal and electric assets on the energy market.

Twelve houses in a Oud-Heverlee neighborhood were equipped with a variety of assets that enabled the use of consumers flexibility potential for various uses: load shifting, peak reduction or demand response. **Among the installed technologies were fuel cells, batteries, small scale thermal storage, seasonal thermal storage with improved monitoring and control.** The storage aimed to store locally produced energy g., by PV and solar panels.



On the household and neighbourhood level, the **main challenge was interoperability and connectivity of the assets included.** Heat pumps and hot water boilers of the participants were upgraded with **SmartPlugs** and **ThermoSmart** temperature sensors, and their control was communicated via the **LoRa network**. In the beginning of the demonstration the selected LoRa network had some operational challenges due to poor signal coverage, which resulted in poor quality data. This was resolved with ICT upgrades and with good data quality together and efficient and reliable control of the flexible units we were able to optimize their operation.

Due to the reasons of dealing with household assets, **customer comfort** heavily dictated the boundary of unit control. It is also very crucial to have **fast and proper customer support** to promptly resolve all issues that appear during operation.

With control of thermal units, the STORY team was able to **capture the available thermal flexibility**, combine it with **electricity flexibility** and offer it to the grid operator in instances when it is needed and **demonstrate how IoT can be utilized for grid services.**

An important outcome of projects developed smart control was an achievement of 10 consecutive days of 100% self-sufficiency of STORY Living Lab house.

10
DAYS

100%
SELF-SUFFICIENT

FINAL THOUGHT

Integration of new devices and control equipment with new or existing infrastructure is very challenging. We have faced issues from non-responsive intelligent thermostats to control algorithm commands for primary-level battery management systems ignoring SCADA control signals. We had overcome these challenges by designing and implementing various solutions which included improved control algorithms and proactive communication with equipment manufacturers to improve the system operation, reliability and safety.

As a lesson learned, we would like to share key steps which all demo establishing processes should have.

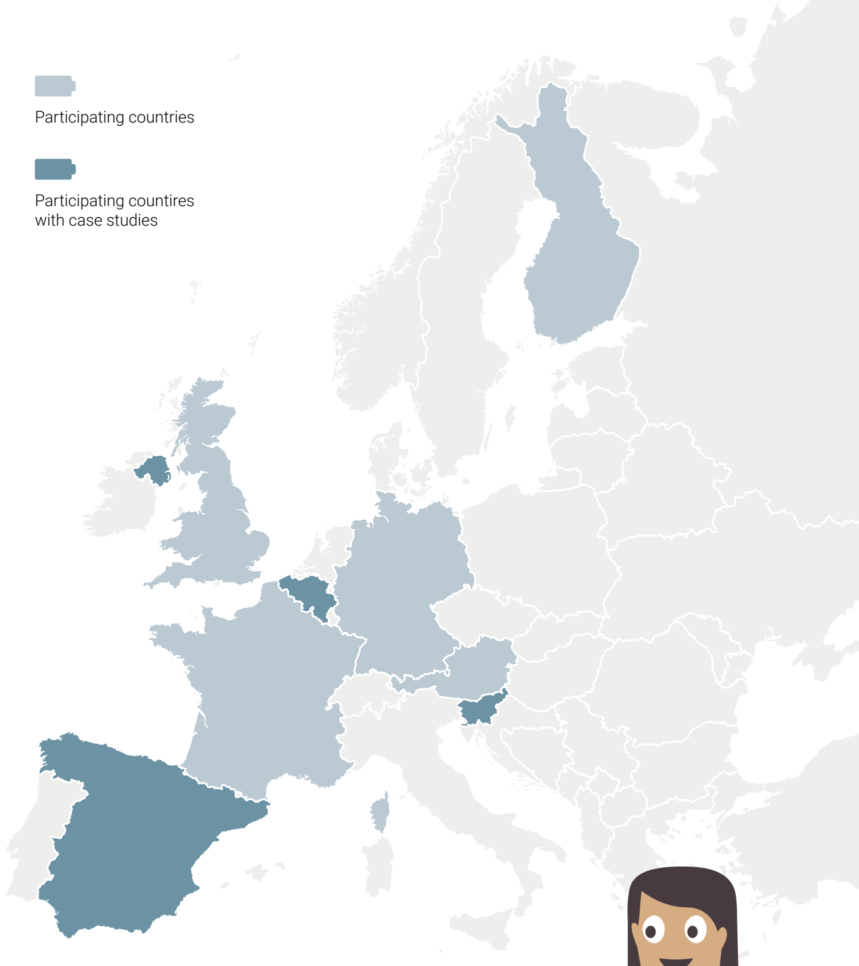
1 **TIME PLAN** to track and adapt progress

2 **PARALLEL ACTIVITIES** to get head start and save time where possible

3 **COMPATIBILITY & CONNECTIVITY** issues must be foreseen and defined in the planning phase of the demo

4 **RESERVED OPTION & MITIGATION MEASURES** when additional challenges appear

5 **OFF THE SHELF & MODULARLY BUILT** implemented solutions to improve ease of integration


Participating countries
Participating countires
with case studies


The STORY may be ending, but the research, innovation and development activities of our partners continue to thrive!

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